ARMY ENGINEER DISTRICT, SACRAMENTO SPK-02442
CORPS OF ENGINEERS March 84
SACRAMENTO, CALIFORNIA Revised Apr 89

TO: Architect-Engineers and District Personnel:

1. The attached revised guide specification supercedes the previous guide, LAWN SPRINKLER SYSTEM, SPK-2L, dated March 1984, and is for use in the preparation of project specifications.

GENERAL NOTES
Para 2

TEXT REVISIONS
Para 1
Para 1.1
Para 1.4
Para 3.1
Para 3.10.1.1
Para 3.10.2
Para 3.10.3
Para 10

NOTE: A-E's should read all the TECHNICAL NOTES located at the beginning of this guide specification and edit the specification accordingly.

SPK-02442
Apr 1989

GENERAL NOTES

1. This guide specification is to be used in the preparation of contract specifications in accordance with the Sacramento District Specification Manual. It will not be made a part of a contract merely by reference; pertinent portions will be copied verbatim into the contract documents.

2. Where numbers, symbols, words, phrases, clauses, or sentences in this specification are enclosed in the following manner: [ ], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where entire paragraphs are not applicable, they should be deleted completely.

TECHNICAL NOTES

A. The section number will be inserted in the specification heading and prefixed to each page number in project specifications.

B. Paragraph 1: The listed designations for publications are those that were in effect when this guide specification was being prepared. These designations are updated when necessary by District Instruction, and references in project specifications need be no later than in the current District Instruction for this guide specification. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues should be retained in Paragraph 1 and omitted elsewhere in the project specification.

C. Paragraph 3.4: Include option for plastic pipe and accessories with the following exceptions. Only plastic pipe will be used at Oakland Army Terminal, McClellan AFB, Hill AFB, Hill AF Range, Vandenberg AFB and Nellis AFB due to soil conditions.

D. Paragraph 3.1.5: Insert number of keys required in blank space.

E. Paragraph 3.13: Vacuum breakers shall be used with pop-up type sprinklers, and shall be selected as required by the sprinkler system layout, applicable safety codes if the water supply is interconnected to off-Base water lines, and comparative costs. For atmospheric type, no shut-off valve shall be placed beyond the vacuum breaker. Fill in

blanks for number GPM and pressure loss for specified vacuum breaker in paragraph 3.13.2.

F. Paragraph 3.13.1: These types of breakers are available in sizes up to and including 2-inch.

G. Paragraph 3.13.3: This assembly shall be used for pipe sizes over 2 inches. Shut-off valve at connection to the distribution main may be used in lieu of shut-off valved called for on inlet side of the assembly at the designer's discretion.

H. Paragraph 3.15: Designer to select type of sprinkler heads. Indicate performance table on drawings including design nozzle pressure, nozzle openings, spacing and pattern desired.

I. Paragraph 3.15.1: Fixed head sprinklers to be used in small, narrow confined areas such as parkways and small lawns.

J. Paragraph 3.15.2: Pop-up head sprinkler system is intermediate in cost and coverage per head, and shall be used in areas too small for quick-coupling or rotary pop-up head systems.

K. Paragraph 3.15.3: Rotary pop-up head sprinklers may be used under the same condition as quick-coupling valves with rotary heads and are particularly applicable for automatic control.

L. Paragraph 3.15.4: Quick-coupling valve system is the most economical of underground sprinkler systems. They shall be used in all areas suitable for largest coverage possible with rotary heads. Rotary sprinkler heads and coupler keys for use with quick-coupling valves will be provided under the construction contract in the quantity necessary for use at any one time and the quantity and type indicated on the drawings. As necessary, part and/or full circle models will be provided. Rubber sleeves shall be specified in athletic fields.

M. Paragraph 4.4.1: Delete reference to frost if not applicable.

N. Paragraph 4.5: Eliminate requirement for drain valve when system is not subjected to frost action.

O. Paragraph 4.11: Delete all paragraphs relative to automatic controller system when manual operation only is designated.

SPK-02442
April 1989

INDEX

SECTION 02442

IRRIGATION SYSTEM

SECTION 02442

IRRIGATION SYSTEM

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specifications:

WW-P-325B	Pipe, Bends, Traps, Caps and Plugs; Lead (for Industrial Pressure, and Soil and Waste Applications).
WW-P-351A	Pipe; Red Brass, (Copper Alloy No. 230), Seamless Standard Pipe Size, Regular and Extra-Strong.
WW-P-421D	Pipe, Cast Gray and Ductile Iron, Pressure, (for Water and Other Liquids).
WW-P-521G	Pipe Fittings, Flange Fittings, and Flanges Steel and Malleable Iron (Threaded and Butt-Welding) Class 150.
WW-T-799F	Tube, Copper, Seamless, Water and Refrigeration (for Use with Solder-, Flared- or Compression-Type Fittings).
WW-U-531F	Unions, Pipe, Steel or Malleable Iron; Threaded Connection, 150 Lb. and 250 Lb.

1.2 American National Standards Institute, Inc. (ANSI) Standards:

A21.11-1980	Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.
B31.1-1986	Power Piping.

1.3 American Society for Testing and Materials (ASTM) Publications:

A 53-87b	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

B 176-86 Copper Alloy Die Castings.

C 296-83 Asbestos-Cement Pressure Pipe.

D 1785-86 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

D 1788-81 Rigid Acrylonitrite-Butadiene-Styrene (ABS) Plastics.

D 2241-86a Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

D 2464-76 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2466-78 Poly (Vinyl Chloride (PVC) Plastic Pipe and Fittings, Schedule 40.

D 2467-87 Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings, Schedule 80.

D 2564-84 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

1.5 American Water Works Association (AWWA) Standard:

C110-87 Ductile-Iron and Gray-Iron Fittings 3 in. Through 48 in., for Water and Other Liquids.

C203-86 Coal Tar Protective Coatings and Linings for Steel Water Pipelines -- Enamel and Tape -- Hot-Applied.

C500-86 Gate Valves--3in. Through 48 in. NPS, for Water and Other Liquids.

C651-86 Disinfecting Water Mains.

1.6 Manufacturers Standardization Society of the Valves and Fittings Industry, Inc. (MSS) Standards:

SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends. (1984)

SP-80 Bronze Gate, Globe, Angle and Check Valves. (1979)

2. GENERAL: Distribution piping may be of any of the types and materials specified herein. The pipe and accessories shall be of new and unused

material. The full length of each section of pipe shall rest solidly upon the pipe bed. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations by means of plugs and caps or other approved methods. The pipe shall not be laid in water or when trench or weather conditions are

unsuitable for the work. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with new pipe without additional expense to the Government.

3. MATERIALS: Materials shall conform to the respective specifications and other requirements specified below.

3.1 Steel Pipe: ASTM A 53, schedule 40, Grade A. Before delivery to the site the pipe shall receive a protective coating conforming to AWWA C203. After installation, any damaged coating or exposed threads of screwed joints shall be given a hot-applied touch-up coat of the specified coating.

3.2 Asbestos-Cement Pipe and Couplings: ASTM C 296, class 150, type II, and the following minimum requirement for 3-inch pipe: (a) Flexural strength total applied load 830 pounds for 10-foot lengths; (b) 6,700 pounds minimum crushing strength total applied load per foot.

3.3 Cast Iron Pipe: Federal Specification WW-P-421.

3.4 Plastic Pipe: Nonthreaded pipe may be used downstream from vacuum breaker only. Pipe shall conform to ASTM D 2241, rigid nonthreaded, or ASTM D 1785, rigid, schedule 40, except that pipe to be threaded shall be schedule 80.

3.5 Copper Tubing: Federal Specification WW-T-799, type K, class 1, annealed. Joints shall be compression pattern, flared, for soft copper water tubing and shall be made with fittings meeting approved standards. Tubing shall be cut off square and expanded with a proper flaring tool. Dielectric couplings shall be provided wherever copper tubing is joined with dissimilar materials.

3.6 Risers:

3.6.1 Brass pipe, when used for risers, shall conform to Federal Specification WW-P-351, class 1.

3.6.2 Plastic pipe, when used for risers, shall conform to ASTM D 2241 and shall meet the requirements for potable water.

3.6.3 Steel pipe, when used for risers, shall conform to ASTM A 53, schedule 40, grade A.

3.7 Fittings and Specials:

3.7.1 For Asbestos-Cement Pipe: Cast iron bell-end, AWWA C110, 150 p.s.i. pressure rating, except that profile of bell may have special dimensions as required by the pipe manufacturer.

3.7.2 For Steel Pipe: Fittings and specials for pipe 4 inches and larger shall be made of the same material as the pipe. Pipe, fittings, and specials shall meet the applicable requirement of paragraph 639 of ANSI Standard B31.1.0, Power Piping. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Fittings and specials for pipe 3 inches and less in diameter shall conform to Federal Specification WW-P-521, type II. All fittings and specials for steel pipe shall receive a protective coating and/or lining as hereinbefore described in paragraph: MATERIALS.

3.7.3 For Cast Iron Pipe: Fittings and specials shall conform to AWWA C110, 150 p.s.i. pressure rating, unless otherwise specified. Specials and fittings for pipe less than 4 inches in diameter shall be either as specified above or shall be all bell with factory-made lead-, screw-, or gland-type joints. Fittings and specials for use with mechanical-joint pipe shall conform to Federal Specificaiton WW-P-421, as applicable. Joints shall be of the bell-and-spigot, mechanical, bolted, or rubber-ring gasket type.

3.7.4 For Plastic Pipe: Fittings shall conform to ASTM D 2464, D 2466, or D 2467, as applicable.

3.8 Joints:

3.8.1 Bolted Joints: Bolts, nuts, and washers shall conform to the recommendations of the pipe manufacturer.

3.8.2 Insulating Joints: Joints between ferrous and nonferrous metallic pipe shall be made up with a suitable nonconducting coupling device.

3.8.3 Mechanical joints shall be of the stuffing-box type and shall conform to Federal Specification WW-P-421 or to ANSI Standard A21.11.

3.8.4 Rubber-Gasket Joints: For cast iron pipe, the gaskets and lubricant shall conform to the applicable requirements of Federal Specification WW-O-421. For asbestos-cement pipe and steel pipe, the gaskets shall be in accordance with recommendations of the pipe manufacturer.

3.8.5 Connections between asbestos-cement pipe and cast iron fittings or gate valves shall be made with jointing materials as specified above for cast iron pipe, or with other approved materials recommended by the pipe manufacturer.

3.8.6 Joints for plastic pipe shall be either threaded or socket welded type.

3.9 Miscellaneous Items:

3.9.1 Corporation stops shall have water-works standard thread on the inlet end, with flanged joint couplings or wiped joints for connections to goosenecks.

3.9.2 Goosenecks: Lead pipe for gooseneck connections shall conform to the applicable requirements of Federal Specification WW-P-325, class 100. Copper tubing for gooseneck connections shall conform to the applicable requirements of Federal Specification WW-T-799, type K, annealed. Length of connections shall be in accordance with standard practice.

3.9.3 Sprinkler Head Housing:

3.9.3.1 Plastic: Plastic housing shall be of the type produced by the same manufacturer as the sprinkler head and designed for the intended use. Plastic material shall conform to ASTM D 1788.

3.9.3.2 Brass: Brass housing shall be cast brass and shall be provided by the same manufacturer as the sprinkler head. Brass shall conform to ASTM B 176.

3.9.3.3 Cast Iron: Cast iron housing shall conform to AWWA C110, and shall be shaped for the intended purpose for which used. The housing shall be supplied by the same manufacturer as the sprinkler head.

3.10 Valves:

3.10.1 Gate Valve: Valves shall be designed for a minimum water working pressure of not less than 150 pounds per square inch. Valves shall have bell or spigot ends or joints as required for the piping in which they are installed. Valves shall be provided with drain tappings where specifically called for on the drawings. Gate valves shall have a clear waterway equal to the full nominal diameter of the valve and shall be opened by turning to the left. The operating nut shall have an arrow cast in the metal, indicating the direction of opening. Each valve shall have the maker's initials and pressure rating cast on the body. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified water working pressure.

3.10.1.1 Valves smaller than 2 inches: Valves smaller than 2 inches shall be all brass and shall conform to the requirements of MSS SP-80, type 2, class 150.

3.10.1.2 Valves 2 inches and larger: Valves 2 inches and larger shall be iron-body, brass-mounted, and shall conform to AWWA C500 or to the requirements

of MSS SP-70, type I, class 150, OS & Y design.

3.10.2 Control valves shall be angle pattern globe type witn integral union

on the discharge (horizontal) end and shall conform in essential requirements to MSS SP-80, type 1, class 150 with notched wheel suitable for operation with a forked wrench.

3.10.3 Swing check valves, 2 inches and larger, shall conform to the applicable requirements of MSS SP-80, type 4, class 150.

3.10.4 Valve stem protectors shall be of cast iron or cut from black or galvanized steel pipe. Inside diameter shall be approximately 2-1/4 inches. Length shall be such that protection will be provided from valve body to ground surface.

3.10.5 Control valve keys shall consist of a D-handle or T-handle, stem, and 2-pronged fork. Overall length shall be approximately 30 inches. They shall be fabricated from steel rod having a diameter of not less than 3/8-inch and shall be galvanized after fabrication. Prongs of the fork shall be spaced to fit into notches of the valve wheel or between spokes of valve wheels. Provide keys.

3.10.6 Zone control valves shall generally conform to the requirements of MSS SP-80, type 1 or 2, Class 150, end connection 1 or 2 with maximum head loss of 5 p.s.i. at 100 gpm and be as follows:

a. All brass 150 lb. W.O.G. class or C.I. body and bonnet with brass fittings.
b. Have a notched wheel for manual operation.
c. Have a 24-V waterproof solenoid protected by a replaceable grit strainer.
d. Have a separate manually adjustable pressure flow regulator.
e. Have a removable bonnet for access to valve interior without removing valve from the line.
f. Have a molded one-piece valve diaphragm with "o" ring compression seal.
g. If control valves of the globe angle screwed pattern are used they shall have an integral union on the discharge side.

3.11 Unions shall conform to the requirements of Federal Specificaiton WW-U-531, type B.

3.12 Automatic Controller System: The Contractor shall furnish and install an automatic controller system complete with electrical requirements for those areas indicated on the drawings. The automatic controller system shall be sized to provide automatic control for the number of zones in each particular area to be controlled from one Controller Panel. The automatic controller

system shall be wall or pedestal mounted, shall be designed by the same manufacturer as the sprinkler system, shall be provided with "automatic" or "manual" switch and all other electrical connections as necessary, and shall be of the type recommended by the manufacturer for the intended use and approved by the Contracting Officer.

3.13 Vacuum Breakers: Vacuum breakers shall be [atmospheric vacuum type,] [pressure vacuum type,] [vacuum breaker and check valve assembly,] or [reduced pressure regulator and double check valve assembly,] and shall consist of a brass or bronze body. The vacuum breakers shall be furnished be a single manufacturer regularly engaged in the production of lawn sprinkler equipment.

3.13.1 Atmospheric Type Vacuum Breaker: The assembly shall consist of a brass or bronze body, air inlet and check valve. The check valve shall be a float that provides positive closure to the air inlet upon initial water flow or pressure and shall open the air inlet and prevent backflow into the supply line when the water flow is turned off. The vacuum breaker shall be the same size as the adjacent control valve.

3.13.2 Pressure Type Vacuum Breaker Assembly: The assembly shall consist of brass or bronze body, spring loaded check valve, vacuum relief, shut-off valves on the inlet and discharge sides, and field test cocks. The pressure loss at g.p.m. shall not exceed p.s.i.

3.13.3 Vacuum breaker or reduced pressure regulator and double check valve assembly: The assembly shall consist of two swing check valves with drain cocks, vacuum relief or reduced pressure controller, and shut-off valves on the inlet and discharge side of the assembly. The pressure loss at g.p.m. shall not exceed p.s.i.

3.14 Hose faucets shall be brass with male inlet threads, hexagon shoulder and 3/4-inch hose connection. Faucet size shall be the same as size of riser pipe.

3.15 Sprinkler heads shall be the product of a single manufacturer regularly engaged in the production of lawn sprinkler equipment.

3.15.1 Fixed Head Sprinklers: The body and nozzle shall be made of brass and the nozzle shall be adjustable from full flow to shut-off. The pattern type, the rate of application at the design nozzle pressure, and the spacing of the sprinkler heads shall be as indicated on the drawings.

3.15.2 Pop-up Sprinklers: The pop-up feature shall consist of a piston to which the nozzle is attached; a type which provides cam, gear, pressure pop-up or other approved pop-up features, and shall be of sufficient height to permit it to rise at least one inch when in operation. The recess for the piston shall be sufficiently deep to contain the piston completely within the body of the sprinkler head. The nozzle shall be interchangeable and adjustable from full flow to shut-off. The body, piston and nozzle shall be made of brass. The pattern type, the rate of application at the design nozzle pressure, and

the spacing of the sprinkler heads shall be as indicated on the drawings.

3.15.3 Rotary pop-up head sprinklers shall be of the full circle or part-circle pattern as indicated. When the system is turned on, the sprinklers shall rise above the ground and rotate slowly; when the system is

turned off, the sprinkler shall drop into the housing and shall be flush or below the ground level. The housing shall be of plastic, brass, cast-iron or other approved material and the sprinklers shall have interchangeable, adjustable nozzles. The rate of application at the design nozzle pressure and the spacing of the units shall be as shown on the drawings.

3.15.4 Quick-coupling valve system shall consist of quick-coupling valves, coupler keys, and rotary sprinkler heads designed for use with quick-coupling valves and shall all be of the same manufacture. The valves shall be spring loaded and close automatically upon removal of the coupler key; the valves shall be opened by a downward thrust against the valve with the coupler key. The body shall be of one or two piece construction and shall be of brass; the valve shall be suitable for maximum operating pressure of 150 p.s.i. The valve cover shall be of brass, cast iron or vinyl covered. Rubber sleeves shall be the standard product of the manfucaturer of quick-coupling valves and when required, they shall replace the hinged cover as regularly furnished. Each sleeve shall have a cover. The sprinkler heads shall be full circle models or combination part and/or full circle models and shall have the capacity and coverage as indicated on the drawings. The heads shall be of brass or aluminum, and the nozzles shall be adjustable to change the coverage pattern.

3.15.5 Lawn spray sprinkler heads shall be all brass with adjustable coverage, pattern, controlled rate of flow and interchangeable nozzles. Rate of application, operating pressure and spacing shall be as indicated on the drawings. Lawn spray sprinkler heads shall pop-up a minimum of 1" when the water is turned on and shall retract at least to the ground level.

3.15.6 Shrub Sray Heads: Shrub spray heads shall be made of brass and the nozzle shall be adjustable from full flow to shut off. The pattern, rate of application, operating pressure and spacing shall be as indicated on the drawing.

3.15.7 Bubbler Heads: Bubbler head shall include adjustable pattern diameter and removable nozzle with all brass with mixing chamber construction and flow control adjustment, and shall be placed at the location and to the dimensions shown on the drawings.

4. INSTALLATION:

4.1 General: Excavation, trenching and backfilling shall be accomplished in accordance with the following requirements unless noted otherwise on the drawings.

4.1.1 The minimum cover over pipe, except where shown otherwise on the

drawings, or as required for system drainage, shall be 6 inches for lines serving stationary sprinkler heads, 8 inches for lines serving pop-up sprinkler heads, and 12 inches for lines serving quick-coupling valves for portable sprinklers.

4.1.2 Plastic pipe shall be installed with special care, as follows:

4.1.2.1 Plastic pipe laid in or across roadways or other locations which will be subject to vehicular traffic shall be placed in steel conduit capable of withstanding the anticipated static and moving loads.

4.1.2.2 Plastic pipe shall be insulated against heat from steam lines, hot water lines or other heat sources.

4.1.2.3 The bedding material used for backfilling to a depth of one foot over plastic pipe shall be free from rock, stones, clods, and other material larger than 1/2 inch in any direction.

4.2 Handling: Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. If the coating or lining of any pipe or fittings is damaged, the repair or replacement shall be made by the Contractor at his expense in a satisfactory manner. Before installation the pipe shall be inspected for defects. Material found to be defective before or after placement shall be replaced with sound material without additional expense to the Government.

4.3 Placing and Laying: Pipe and accessories shall be carefully lowered into the trench by means of ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the pipe connection materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section or pipe shall rest solidly upon the pipe bed, with recesses excavated to accomodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until the material in the joints has hardened or until calking or jointing is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipe or fittings. Where any part of the coating is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Asbestos-cement pipe shall be installed in accordance with recommendations of the pipe manufacturer. Pipe ends left for future connections shall be valved, plugged or capped, and anchored, as shown or as directed. Where prescribed by the manufacturer of the pipe, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber

gasket shall be checked with a feeler gage in accordance with the pipe manufacturer's recommendations.

4.4 Connection to main shall be as described below unless shown otherwise on the drawings.

4.4.1 Supply lines 1-1/2 inches and smaller shall be connected to the main by a corporation-type stop and a lead or copper gooseneck, with a service stop below the frostline.

4.4.2 Two-inch supply lines shall be connected to the main with a rigid connection or a corporation-type stop and lead or copper gooseneck, and shall have a gate valve located below the frostline. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard-quality branch connections in conformance with recognized standard practice. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

4.4.3 Supply lines larger than 2 inches shall be connected to the main by a rigid connection.

4.5 System drainage: Each sprinkler circuit shall be laid for complete drainage to a drain valve placed as shown on drawings.

4.6 Joints: After cutting and before threading, pipe shall be reamed and shall have burrs removed. Screw joints shall be made with graphite or inert filler and oil or with an approved graphite compound applied to male threads only. Threads shall be full cut, and not more than 3 threads on the pipe shall remain exposed. Calking of threaded joints to stop or prevent leaks will not be permitted. Unions shall be provided where required for disconnection. Nonthreaded joints shall be made to comply with manufacturer's recommendation and/or as hereinafter specified.

4.6.1 The installation of steel couplings, asbestos-cement couplings, mechanical joints, and bolted joints shall be in accordance with the recommendations of the manufacturer.

4.6.2 Joints for copper tubing shall be compression-pattern, flared, for soft-copper water tubing and shall be made with fittings meeting approved standards. The tubing shall be cut off square and expanded with an acceptable flaring tool.

4.6.3 Joints for plastic pipe shall be either threaded or socket-type. Socket type joints shall be used downstream from the vacuum breaker only. Socket-type joints shall be made using a special cement of the solvent type, per ASTM D 2564, and proven by field demonstration as being satisfactory to the Contracting Officer. The socket and the pipe or fitting which fits in the socket shall be free of dirt, grease, or foreign matter. The solvent cement shall be applied with a natural bristle brush inside the socket and to the pipe

for a length equal to the socket depth. The socket and pipe shall immediately be forced together with a slight, twisting motion, if possible, to insure full engagement of pipe into the socket. Reasonable handling is permissable within 2 minutes after joining. Line pipe shall be assembled above ground and when installed shall be "snaked" to provide for expansion and contraction. Snaking shall be such as to touch opposite side of trench in 50 feet.

4.6.4 Branch line connections to risers shall be as shown on the drawings.

4.7 Sprinkler Heads:

4.7.1 Sprinkler heads and valves shall be installed in accordance with the recommendations of the manufacturer. Uniform and complete coverage of the areas to be irrigated shall be obtained without excessive overlapping. All sprinkler heads of the same type and capacity on a single control valve shall be adjusted to provide coverage consistent with each other.

4.7.2 Variation in arrangement of sprinklers from those shown on drawings will be permitted. If such variation is made, the Contractor shall submit a shop drawing for approval.

4.8 Quick coupler valves shall be installed in accordance with details shown on drawing and flush with finish lawn.

4.9 Angle control valves shall be installed below grade with valve sleeve to grade and secured to valve.

4.10 Sprinkler Head Housing: Sprinkler head housing shall be [cast iron,] [brass casting,] or [plastic]. Installation shall conform to the recommendations of manufacturer and shall be flush with the final finished surface or slightly below in its final position.

4.11 Automatic Controller System: Automatic controller system shall be installed at the location shown on the drawings, unless otherwise directed. Installation shall include connection to power supply of 105 to 125 volts and power step-down transformer connections to the individual valve solenoids as required for the automatic controller system. All electrical material provided and installed shall meet the latest issue of the electrical code for the area and all electric wire shall be U/L approved. The Controller unit shall be provided with waterproof and dustproof cover. After completon of the installation, the system shall be adjusted, and field tested to assure compliance with the manufacturer's capabilities and operational control of each zone or station to satisfy the design requirements. All tests and operational compliance shall be accepted and approved by the Contracting Officer.

4.12 Vacuum breaker shall be of the type and size as specified herein before and designated on the drawings.

4.12.1 Atmospheric-Type Vacuum Breaker: Atmospheric-type vacuum breaker shall be furnished and installed as indicted on the drawings and placed on the discharge side of the last shut-off valve. Combination control valve and

vacuum breaker may be installed. The unit shall be installed at least 6 inches above the highest sprinkler.

4.12.2 Pressure-Type Vacuum Breaker Assembly: Pressure-type vacuum breaker assembly shall be furnished and installed as indicated on the drawings to offer protection under a continuous pressurized supply line. The unit shall be installed at least one foot above the highest sprinkler.

4.12.3 Vacuum Breaker and Check Valve Assembly: The vacuum breaker and check valve assembly shall be furnished and installed as indicated on the drawings. The vacuum breaker portion of the assembly shall be installed at least one foot above the highest sprinkler.

4.13 Hose Faucets: The Contractor shall furnish and install hose faucets at the location shown on the drawings. Hose faucets shall be installed to allow ample room for easy hose connection. Hose faucet shall not leak in the closed position.

4.14 Valves: The Contractor shall furnish and install valves and accessories of the various types required for the system being constructed. Location of the valve shall be determined by the design features of the sprinkler system and shall be installed to provide complete control of the sprinkler system.

4.15 Unions: The Contractor shall furnish and install unions in the sprinkler system wherever required to simplify pipe installation.

5. FLUSHING: Each unit of completed supply line and distribution system including sprinkler risers shall be flushed thoroughly with a full head of water before installing sprinklers.

6. TESTS: After the pipe is laid, the joints completed, and the trench partially backfilled, leaving the joints exposed for examination, the piping shall be subjected to pressure tests of one hour minimum duration as follows:

6.1 Connection to existing main including vacuum breaker assembly piping shall be subjected to a hydrostatic test pressure of 150 psi for one (1) hour. If loss of pressure occurs, the leaks shall be repaired and the line shall be retested. The repair and retesting shall be at the Contractor's expense. The Contractor has the option of disinfecting the connections at the main pipe to the vacuum breaker and vacuum breaker assembly concurrently with pressure testing if for any reason the tested portion of the installation becomes contaminated. The disinfection treatment shall be reaccomplished by the Contractor at no additional cost to the Government. Disinfection shall be as prescribed by AWWA Standard C651. All tests and disinfection results shall be satisfactory to the Contracting Officer.

6.2 All sprinkler mains and distribution piping on a sprinkler side of vacuum breaker assembly piping shall be subjected to a hydrostatic test pressure of 100 p.s.i. for one (1) hour. Cracked or defective pipe, fittings, or valves disclosed in the pressure test shall be replaced by the Contractor with sound material at no addtional cost to the Government, and the test shall be repeated until the test results are satisfactory.

6.3 If solvent welded joints are used for plastic pipe the line shall not be subjected to pressure testing for 24 hours following the completion of the line to be tested.

7. TOOLS: Two sets of special wrenches for removal, flow regulation and/or installation of sprinkler heads shall be provided at locations designated by the Contracting Officer.

8. OPERATING INSTRUCTIONS: The Contractor shall provide a schematic piping diagram of the sprinkler layout showing all drains and valves.

9. CLEANUP: Upon completion of the installation of the sprinkler system and appurtenances, all debris and surplus materials resulting from the work shall be removed.

10. CONSTRUCTION QUALITY CONTROL: Attention is directed to SECTION: CONSTRUCTION QUALITY CONTROL which requires the Contractor to perform quality control inspection, testing, and reporting.

* * * * *

- REMINDER -

Located at the front of these specifications are the Contract Clauses, Special Clauses and Division I GENERAL REQUIREMENTS of the Technical Specifications, which apply to every aspect of this contract including the work in this section whether performed by Prime Contractor, subcontractor, or supplier.